IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Patrick D. Smith et al.

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Title: METHOD AND APPARATUS FOR AUTOMATED CORRELATION
                OF DIGITAL MODULATION IMPAIRMENT
Art Unit: 2631

Docket No.:   BCS03393

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

IN THE CLAIMS

1.   (Currently Amended) A method for identifying impairments in a digitally

modulated signal comprising ~~the steps of~~:

        obtaining soft decision data derived from the digitally modulated signal;

        applying a plurality of <u>predefined</u> impairment masks to the soft decision

data, each impairment mask <u>is a set of undesired values associated with the digitally</u>

<u>modulated signal and is</u> associated with a different impairment type;

        determining a subset of the soft decision data that occur within each

<u>predefined</u> impairment mask;

        calculating a correlation weight based on each subset; and

        based on the correlation weights, determining a likelihood that a particular

impairment type is affecting the digitally modulated signal.

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2.   (Presently amended) The method of claim 1 further comprising ~~the steps~~

~~of~~:

normalizing the soft decision data.

3.   (Presently amended) The method of claim 2 wherein the impairment

masks are selected from a group consisting of:

a phase noise impairment mask;

a continuous wave noise impairment mask;

a signal reflection impairment mask;

an I/Q imbalance impairment mask;

a compression impairment mask;

an amplitude-modulation-to-phase-modulation impairment mask; and

a composite phase noise and continuous wave noise impairment mask.

4.   (Presently amended) The method of claim 2 further comprising ~~the step~~

~~of~~:

providing a three-dimensional presentation of a distribution of the soft

decision data over time.

5.   (Presently amended) The method of claim 1 further comprising ~~the step~~

~~of~~:

providing information descriptive of a distribution of occurrences of soft

decision data within specific regions of the impairment masks.

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6.   (Canceled)

7.   (Presently amended) A method for detecting impairment of a digital

signal comprising ~~the steps of~~:

calculating a first correlation weight for a first predefined symbol-level

impairment mask wherein the first predefined symbol-level impairment mask is a first set

of undesired values associated with the digital signal;

storing the first correlation weight;

calculating a second correlation weight for a first predefined constellation-

level impairment mask, the first predefined constellation-level impairment mask

operative to detect a different impairment type than the first predefined symbol-level

impairment mask and wherein the first predefined constellation-level impairment mask is

a second set of undesired values associated with the digital signal;

storing the second correlation weight; and

calculating an overall correlation weight based on the first correlation

weight and the second correlation weight.

8.   (Presently amended) The method of claim 7 further comprising ~~the steps~~

~~of~~:

calculating a third correlation weight for a second predefined symbol-level

impairment mask wherein the second predefined symbol-level impairment mask is a third

set of undesired values associated with the digital signal;

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storing the third correlation weight;

calculating a fourth correlation weight for a second <u>predefined</u>

constellation-level impairment mask <u>wherein the second predefined constellation-level</u>

<u>impairment mask is a fourth set of undesired values associated with the digital signal</u>; and

storing the fourth correlation weight; wherein the ~~step of~~ calculating the

overall correlation weight based on the first correlation weight and the second correlation

weight further includes ~~the step of~~ calculating the overall correlation weight based on the

first correlation weight, the second correlation weight, the third correlation weight, and

the fourth correlation weight.

9.   (Presently amended) The method of claim 8 further comprising ~~the step~~

~~of~~:

measuring a quality of the digital signal.

10.   (Presently amended) The method of claim 9 wherein the ~~step of~~ measuring

a <u>the</u> quality of the digital signal further comprises ~~the step of~~:

checking a signal-to-noise ratio.

11.   (Presently amended) The method of claim 7 wherein the first <u>predefined</u>

symbol-level impairment mask is selected from a symbol-level impairment mask group

consisting of:

a phase noise impairment mask;

a continuous wave noise impairment mask;

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a composite phase noise and continuous wave noise impairment mask; and

a signal reflection impairment mask;

and wherein the first <u>predefined</u> constellation-level impairment mask is

selected from a constellation-level impairment ~~trade~~ <u>mask</u> group consisting of:

an I/Q imbalance impairment mask;

a compression impairment mask; and

an amplitude-modulation-to-phase-modulation impairment mask.

12.   (Presently amended) A digital receiving apparatus comprising:

a receiver responsive to a digitally modulated signal to perform conversion

of the digitally modulated signal to soft decision data; ~~and~~

an impairment correlator operatively coupled to the receiver and

responsive to the soft decision data to correlate a plurality of different types of

impairments of the digitally modulated signal <u>by using a plurality of predefined</u>

<u>impairment masks wherein each impairment mask is a set of undesired values associated</u>

<u>with the digitally modulated signal; and</u>

<u>a system controller operatively coupled to the impairment correlator to</u>

<u>receive a correlation weight from the impairment correlator to determine a likelihood that</u>

<u>a particular impairment type is affecting the digitally modulated signal</u>.

13.   (Previously presented) The digital receiving apparatus of claim 12 further

comprising:

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a memory device operatively coupled to the impairment correlator to store

a ~~the~~ plurality of impairment masks ~~associated with the plurality of different types of~~

~~impairments~~.

14.   (Original) The digital receiving apparatus of claim 13 further comprising:

an error vector magnitude mask subsystem operatively coupled to the

receiver and responsive to the soft decision data to assess a quality of the soft decision

data.

15.   (Original) The digital receiving apparatus of claim 14 wherein the error

vector magnitude mask subsystem further comprises:

a SNR analyzer operatively coupled to the receiver and responsive to the

soft decision data; and

an error vector magnitude mask memory device operatively coupled to the

SNR analyzer to provide an error vector magnitude mask to the SNR analyzer.

16.   (Presently amended) The digital receiving apparatus of claim 13 <u>wherein</u>

<u>the</u> ~~further-comprising~~ ~~a~~ system controller ~~operatively-coupled to the impairment~~

~~correlator to receive a correlation weight from the impairment correlator and to effect~~

~~control of~~ <u>controls</u> the digital receiving apparatus in response to the correlation weight.

17.   (Presently amended) The digital receiving apparatus of claim 13 <u>wherein</u>

<u>the</u> ~~further-comprising~~ ~~a~~ system controller ~~operatively-coupled to the impairment~~

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~~correlator to receive a correlation weight from the impairment correlator and to effect control of~~ controls a transmitter in response to the correlation weight, the transmitter operatively coupled to the receiver to provide the digitally modulated signal to the receiver.

18. (Presently amended) The digital receiving apparatus of claim 13 <u>wherein the</u> ~~further comprising a~~ system controller ~~operatively-coupled to the impairment correlator to receive a correlation weight from the impairment correlator and to effect control of~~ <u>controls</u> a medium in response to the correlation weight, the medium operatively coupled to the receiver to convey the digitally modulated signal to the receiver.

19. (Presently amended) A cable modem comprising:

a cable modem receiver responsive to a downstream signal to perform conversion of the downstream signal to soft decision data; ~~and~~

an impairment correlator operatively coupled to the cable modem receiver and responsive to the soft decision data to correlate a plurality of different types of impairments of the downstream signal <u>by using a plurality of predefined impairment masks wherein each impairment mask is a set of undesired values associated with the downstream signal; and</u>

<u>a system controller operatively coupled to the impairment correlator to receive a correlation weight from the impairment correlator to determine a likelihood that a particular impairment type is affecting the downstream signal.</u>

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20.   (Previously presented) The cable modem of claim 19 further comprising:

a memory device operatively coupled to the impairment correlator to store

a the plurality of impairment masks associated with the plurality of different types of

impairments.

21.   (Original) The cable modem of claim 20 further comprising:

a cable modem transmitter operatively coupled to the impairment

correlator to transmit a correlation weight from the impairment correlator to a cable

modem termination system.

22.   (Original) The cable modem of claim 20 further comprising:

an error vector magnitude mask subsystem operatively coupled to the

cable modem receiver and responsive to the soft decision data to assess a quality of the

soft decision data.

23.   (Original) The cable modem of claim 22 wherein the error vector

magnitude mask subsystem further comprises:

a SNR analyzer operatively coupled to the cable modem receiver and

responsive to the soft decision data; and

an error vector magnitude mask memory device operatively coupled to the

SNR analyzer to provide an error vector magnitude mask to the SNR analyzer.

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24.   (Presently amended) A cable modem termination system comprising:

a cable modem termination system receiver responsive to an upstream

signal to perform conversion of the upstream signal to soft decision data; ~~and~~

an impairment correlator operatively coupled to the cable modem

termination system receiver and responsive to correlate a plurality of different types of

impairments of the upstream signal <u>by using a plurality of predefined impairment masks</u>

<u>wherein each impairment mask is a set of undesired values associated with the upstream</u>

<u>signal; and</u>

<u>a system controller operatively coupled to the impairment correlator to</u>

<u>receive a correlation weight from the impairment correlator to determine a likelihood that</u>

<u>a particular impairment type is affecting the upstream signal</u>.

25.   (Previously presented) The cable modem termination system of claim 24

further comprising:

a memory device operatively coupled to the impairment correlator to store

~~a~~ <u>the</u> plurality of impairment masks ~~associated with the plurality of different types of~~

~~impairments~~.

26.   (Original) The cable modem of claim 25 further comprising:

a network management system operatively coupled to the impairment

correlator to provide a corrective control signal to a cable modem transmitting the

upstream signal.

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27. (Original) The cable modem termination system of claim 25 further comprising:

an error vector magnitude mask subsystem operatively coupled to the cable modem termination system receiver and responsive to the soft decision data to assess a quality of the soft decision data.

28. (Original) The cable modem of claim 27 wherein the error vector magnitude mask subsystem further comprises:

a SNR analyzer operatively coupled to the cable modem termination system receiver and responsive to the soft decision data; and

an error vector magnitude mask memory device operatively coupled to the SNR analyzer to provide an error vector magnitude mask to the SNR analyzer.

29. (Presently amended) A data structure program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform a method steps for identifying impairment of a digitally modulated signal received by the machine, the method steps comprising:

applying a plurality of predefined impairment masks to soft decision data received from the digitally modulated signal, each impairment mask is a set of undesired values associated with the digitally modulated signal and is associated with a different impairment type;

determining a subset of the soft decision data that occur within each predefined impairment mask;

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calculating a correlation weight based on each subset; and

based on the correlation weights, determining a likelihood that a particular

impairment type is affecting the digitally modulated signal.

30.   (Presently amended) The data structure program storage device of claim

29 wherein the method steps further comprises comprise:

normalizing the soft decision data.

31. (Previously presented) The data structure program storage device of claim 30

wherein the impairment masks are selected from a group consisting of:

a phase noise impairment mask;

a continuous wave noise impairment mask;

a signal reflection impairment mask;

an I/Q imbalance impairment mask;

a compression impairment mask;

an amplitude-modulation-to-phase-modulation impairment mask; and

a composite phase noise and continuous wave noise impairment mask.

32.   (Presently amended) The data structure program storage device of claim

29 wherein the method steps further comprise comprises:

providing a three-dimensional presentation of a distribution of the soft

decision data over time.

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33.   (Presently amended) The <u>data structure</u> ~~program storage device~~ of claim

29 wherein the method ~~steps~~ further <u>comprises</u> ~~comprise~~:

providing information descriptive of a distribution of occurrences of soft

decision data within specific regions of the impairment masks.

34.   (Canceled)

35.   (Presently amended) A method for identifying a type of impairment in a

system communicating a digitally modulated signal comprising ~~the steps of~~:

obtaining soft decision data derived from the digitally modulated signal;

performing ratio analysis on the soft decision data <u>with respect to a</u>

<u>predefined reference point</u>; and

reporting a likelihood that a plurality of types of impairments

corresponding to the ratio analysis are affecting the digitally modulated signal.

36.   (Original) The method of claim 35 further comprising the step of:

providing a three-dimensional presentation of a distribution of the soft

decision data over time.

37.   (Canceled)

38.   (Presently amended) A <u>data structure</u> ~~program storage device~~ readable by

a machine, ~~tangibly~~ embodying a program of instructions executable by the machine to

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perform a method ~~steps~~ for identifying impairment of a digitally modulated signal

received by the machine, the method ~~steps~~ comprising:

deriving soft decision data derived from the digitally modulated signal;

performing ratio analysis on the soft decision data derived from the

digitally modulated signal with respect to a predefined reference point; and

reporting a likelihood that a plurality of types of impairments

corresponding to the ratio analysis are affecting the digitally modulated signal.

39.   (Original) The data structure ~~program storage device~~ of claim 38 wherein

the method ~~steps~~ further comprises ~~comprise~~:

providing a three-dimensional presentation of a distribution of the soft

decision data over time.

40-46. (Cancelled)

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